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ABSTRACT

The observational data from a project which was designed to implement and monitor the effects of an inservice program in facilitating a non-sexist approach to the teaching of science in Australian primary schools are reported in this paper. Descriptions and analyses are provided both of the children's participation in activity-centered lessons on electricity and the nature of the teachers' interactins with the children. All 20 participating teachers received instruction in the teaching of electricity but only ten were designated as the experimental group which was involved in an awareness program on the possibilities of sexism in the physical sciences. Results of this study showed that in the experimental classes, boys and girls in mixed-sex and single-sex groups exhibited the same pattern of activity, whereas the control classes showed behavior differences in the mixed-sex group. It was concluded that single-sex grouping may be beneficial to girls' science education in cases where teachers have a low level of awareness and skills in relation to creating and maintaining a non-sexist learning environment. (ML)

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A Comparison of Mixed-sex and Single-sex Grouping in Year 5 Science Lessons

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Abstract

This paper reports data from observations conducted in Year 5 classrooms, during lessons in which the students were working on an electicity topic. Twenty classes participated in the study. The 20 teachers involved were selected as 10 pairs, matched for sex, educational background and teaching experience. All the teachers received special help to increase their skills and confidence in teaching about electricity. Half the teachers (the "experimental group") were also exposed to an inservice program which alerted them to the possibilities of sexism in the physical sciences.

For science activities the students worked in small groups of two or three. In the classes of the "experimental group" teachers, the same pattern of activity was found for boys and girls in mixed-sex and single-sex groups. In the "control group" classes, however, while the patterns of activities were fairly similar for boys and girls in single-sex groups, this was not the case for mixed-sex groups.

The results of this study indicate that single-sex grouping may be beneficial to girls' science education in cases where teachers have a low level of awareness and skills in relation to creating and maintaining a non-sexist learning environment.

A Comparison of Mixed-sex and Single-sex Grouping in Year 5 Science Lessons

This paper reports observational data from Year 5 science classrooms in Western Australia and focuses on the nature and extent of boys' and girls' participation during group work in science activities. The research was part of a major project entitled The Effect of Inservice Training on Teacher Attitudes and Primary School Classroom Climates (Rennie, Parker & Hutchinson, 1985). The general aim of the project was to devise, implement, and monitor the effects of an inservice program designed to facilitate a non-sexist approach to the teaching of science in primary schools.

The project was conducted in a context of reported underparticipation and underachievment of girls, relative to boys, in the physical sciences, and the subsequent disadvantage at which this places girls in relation to the pursuit of occupations and careers in a technological society (Parker, 1984). There is an increasing tendency to see the primary school years as critical in relation to the formation of positive attitudes by girls toward science (see, for example, Kelly, 1982). Ormerod and Wood (1983) point out that without attention to the primary level "secondary science is merely conducting a somewhat forlorn rearguard action to divert girls' interests towards physical science".

In Australian primary schools, as in the United States and Great Britain, barely 60 minutes each week are devoted to science at this level. It is therefore most important that this time represents high quality science learning experiences, which maximise each child's opportunity to participate in the science activities in a meaningful way. The research reported here describes and analyses the observed participation of children in activity-centred science lessons. The results suggest how teachers can optimise the effectivenss of the "hands-on" part of their science lessons.

The Research Project

The major research project, of which these data are a part, had three specific aims. First the project aimed to raise teacher awareness of the adverse long-term effect on girls produced by the general tendency in the community to see the physical sciences as an almost exclusively male domain. As a consequence of such raised awareness it was considered that teachers would develop a more positive attitude towards the participation of girls in the physical sciences. A second objective of the project was to assist teachers to acquire skills in creating and maintaining a non-sexist science classroom environment, while simultaneously giving them the opportunity to update their knowledge and skills in relation to Electricity, the particular physical science topic selected.

The third specific objective was to monitor the effectiveness of the program by

(a) assessing the nature and extent of attitude change and skills acquisition amongst the teachers;

(b) assessing the nature and extent of any changes in attitude towards science amongst the children, with specific reference to electricity; and

(c) observing and documenting the patterns of classroom interaction during the teaching of the topic Electricity.

It is the last phase of the evaluation of the project's effectiveness which is reported here. A full description of the results is available in Rennie, Parker and Hutchinson (1985).

The research was implemented in a field study focusing on Year 5 of primary school, using two matched groups of ten teachers and their classes. Teachers were matched on the basis of their responses to a questionnaire designed to measure their attitudes and teaching methods in science, and certain biographical data. Once selected, teachers from each matched pair were randomly assigned to an experimental or control group. The experimental group participated in two separate days of inservice work, one week apart, comprising half of a day about teaching a physical science topic (Electricity), and one and a half days designed to raise

teacher awareness of reported differences in attitudes and achievements of boys and girls in science, the need for all children to develop skills in, and positive attitudes toward, physical science, and techniques to help achieve this goal. The control group participated in a half-day inservice course which focused only on skills for teaching the Electricity topic. Thus the experimental design controlled for any changes which might have been due to extra inservicing in science-teaching skills.

Following the inservice courses, the teachers taught a sequence of six lessons on Electricity following the syllabus, approach and procedures presented at the inservice. During the teaching of Electricity, the researchers visited each classroom to record observational details of the children and teacher at work. One male and one female teacher from the control group elected not to teach this topic and took no further part in the research.

Method of Classroom Observation

For the purpose of this research, teachers were asked to teach their science lessons in a certain way. Classes were expected to do a sequence of activities with a typical lesson consisting of children working in groups with equipment, with perhaps a teacher-led whole-class presentation at the beginning and end of the lesson. This common format reduced the number of instructional variables operating in the

research, and in terms of organisational variables, data were collected only on the the size and composition of the groups.

Observational data measuring children's participation in science were structured by focusing on the nature of the children's activities for the duration of the lesson, and the nature of the teacher's interactions with the children. The collection of data was facilitated by recognising two instructional contexts. Whole-class instruction occurs when the teacher works with the class as a unit. Typical teaching activities include information giving, explanation, question-answer session, and class discussion. Group work occurs when children interact in small groups with or without equipment and materials. In this context, teachers interact with groups or individual children. Children may work alone for short periods within either context, and in this study individual work was coded as part of group work because it usually involved recording of group activities.

During whole class instruction, both teacher-student interactions and the participation of children were recorded, but are not reported here. During group work, observations were recorded using the Group Work Schedule which included a section to record the nature and extent of children's participation in the lesson, and a teacher-student interaction section to code the nature and circumstances of the interactions between the teacher and groups of

students. The development and use of the Group Work Schedule, together with the observation schedules developed for whole-class instruction are described in Rennie, Parker and Hutchinson (1984). Only instruments measuring overt behaviour were prepared. Measurement of covert time-on-task requires interview and/or questionnaire methods and the collection of data by these means would have been more time-consuming than the constraints of the project would allow. More importantly however, the research focused on Year 5 classrooms engaged in activity-based science lessons in which nearly all participatory behaviour may be expected to be overt.

Each of the eighteen classrooms in the research study was observed for one science lesson of about one hour in length. Classes averaged 31 children present at the time of observation. The lesson in most cases involved making a switch. Children's activities during group work were coded in six categories: watching or listening to other group members; reading or writing; manipulating equipment; planning/discussing their work; other-on-task behaviour, such as finding equipment, borrowing a pencil, talking with the teacher; off-task behaviour. The activities of each boy and girl were recorded within his/her group, so that patterns of activity could be examined for children in same-sex and in mixed groups. Data for group work were collected by two

observers each observing one half of the class. One sweep of each half-class was made every 90 seconds and teacher-student interactions were recorded when they occurred. These data were combined to give average results in each class for boys and girls in same sex or mixed groups. The process of data combination took account of different numbers of children in groups, and different combinations of the types of groups coded by each observer.

Observation of one hour in each of a number of classrooms might typically be described as "thin" description (Brophy, 1979). However, in this research a number of variables necessitating longer periods of observation for stable measurement have been controlled. Most importantly, context variables relating to subject matter, instructional objectives, and general variables relating to teacher background, attitudes and perceptions about teaching the topic have been incorporated into the research design of the larger study.

Results

Children worked in pairs or threes using the electrical materials for an average of 64 percent of class time, about 40 minutes of an hour lesson. During both whole class instruction and group work chidlren were on task for about 94% of the time, an indication of the success of the lessons. The results in Table 1 show how boys and girls used their time during group work.

Table 1 about here

Children spent most of their time actually working with and manipulating the electrical equipment. There are some interesting comparisons of time spent by boys and girls on the various activities. Table 1 shows first, that there is little difference between the pattern of time spent on each activity by boys whether in same-sex or mixed groups, and this pattern is similar between the experimental and control groups of teachers. Second, the pattern of time spent on activities by girls in same-sex groups matches the pattern for boys in same-sex groups, and these patterns are similar between the two teacher groups. Third, in mixed groups taught by the experimental group of teachers, boys and girls spent about the same amount of time on each activity, except that girls spent a little more time watching/listening. Compared to girls in all-girl groups, girls in mixed groups spent less time reading/writing and more time watching/listening. Almost the same amount of time was spent manipulating equipment. Fourth, in mixed groups taught by teachers in the control group, girls spent nearly 25 per cent less of their time manipulating equipment than did boys. The corresponding comparison for the experimental group is three per cent. Girls spent nearly one quarter of their time

watching/listening, while boys spent only six per cent of their time in this passive involvement.

Participation by the experimental group of teachers in the inservice course is associated here with more active involvement of girls in the activities of group work. In classes taught by control group teachers girls in mixed groups were more likely than boys to watch or listen while the boys spent more of their time manipulating equipment. Compared to girls in all-girl groups, girls in mixed groups spent 14 per cent more time watching/listening, about the same time reading/writing and 12 per cent less time experimenting. The corresponding comparisons in the experimental group show that girls in mixed groups spent nine per cent more time watching/listening than girls in all-girl groups, nine per cent less time reading/writing and one per cent more time experimenting.

During the collection of group work data, the observers took note of how the groups were formed. In most cases children worked with their usual seating partner, in other cases children selected their own partner, usually of the same sex. Other times the teacher moved children into groups which were sometimes same-sex, and sometimes mixed groups. The observers noticed that children in teacher-made groups did not work as well together as did children-choice groups or usual-partner groups. As the time spent manipulating

equipment is the activity requiring the most sharing and working together, an ex post facto analysis of this data was made and the results appear in Table 2.

Table 2 about here

The figures in Table 2 suggest that nearly all children spend more time with the equipment when they are working with their friends or their usual seating partner, than when in groups selected for that lesson by the teacher. A possible explanation, based on this analysis and classroom observation, is that children more readily share tasks in a cooperative way when they are working with someone they know well. This results in higher average time manipulating the equipment than if there is indecision about who does what. The only exception is for boys in mixed groups formed by the control group teachers. These boys spent most of their time using the equipment, and the difference between boys and girls is greatest in this group. The pattern of results for mixed-sex groups is similar to that shown in Table 1 - girls use the equipment less than boys. Only in usual-partner or child-selected groups in classes taught by experimental group teachers did boys and girls have an equal share of hands-on experiences.

Informal Observation

In addition to completing the observational schedules,

the researchers made anecdotal records of conversations between teachers and students, and among students. Usually the discussion related to students' progress and execution of the task in hand, but some comments relevant to the research were interesting. One example involved a control group teacher who several times instructed girls with equipment problems to "go and ask the boys". Whilst it is reasonable to ask students to seek help from their peers, it may have been better to avoid this particular phrase and simply name students who were coping well - many of whom were girls.

In another example, a boy and girl seated directly in front of one observer were given the task of making a switch. The boy took the equipment and began work. The girl alternated between watching and looking about the room. On two separate occasions the teacher passed by and instructed the boy to share the equipment and work together. After the second visit by the teacher, the boy turned to other boys behind and said "This is men's work. You can't let the girls do this - they'll only mess it up."

It may be coincidence that these incidents, and the several others of similar ilk occurred in control group classes. The important thing is to recognise that directly and indirectly, girls are often "put down" by such verbal exchanges.

Discussion

The results show that when children work in groups on

science activities, they do so with a very high level of time-on-task. However, there can be a good deal of variation in what different members of the group are doing. In particular, girls in mixed-sex groups may miss out on their share of the "hands-on" experiences. This is less likely to happen when the girls in mixed groups are working with their chosen friends or their usual desk partners. The observers noted a frequent pattern of events in teacher-formed mixed groups. Boys tended to take the equipment and work on the task until they had finished. When the boys put the equipment down, the girls picked it up and began the task for themselves. Several teachers in the experimental group reported that, initially, girls lacked confidence and familiarity with the materials compared with the boys. However, by half-way through the topic girls had settled in and become more confident in working with the equipment and in solving their own problems. Overall these results suggest that when teachers are made aware that girls might be missing out, and provided with a convincing rationale as to why girls should not miss out, they can help to prevent this from happening.

In a review of research about "hands-on" science programs, Shymansky, Kyle and Alport (1982) found that children achieved more, liked these programs more, and improved their skills more, than did children in traditional text-book based science classrooms. Their findings uphold

the "hands-on" approach to science adopted by the Education Department in Western Australia. The classroom observation in this research revealed several factors which teachers might consider to ensure that all children participate equally and effectively in science activities. Some are common sense. First, those teachers who had equipment organised on desks, or ready to give out, saved considerable lesson time which in other classes was wasted because both teachers and children spent time chasing equipment. Second, in a topic such as electricity, groups larger than two do not work well. Six hands are too many to share in manipulating the equipment, and someone misses out. If insufficient equipment was available, teachers successfully rotated activities. Third, teachers should be aware of the difficulties some girls experience when using equipment unfamiliar to them. A little extra time and encouragement early on will help their confidence so they can cope easily. Fourth, some children do not work well in mixed groups. Teachers must ensure that groups are formed in which all children work equitably and cooperatively. Mixed groups can be very effective, but children need to get used to working with each other, otherwise some group members, often the girls, are likely to miss out on their share of the "hands-on" science activities.

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Table 1

Percentage of Time Spent on Activities by Children in Same-sex and Mixed Groups

Composition of Group	Activities					
	Watching/ Listening	Reading/ Writing	Manipulating Equipment	Planning/ Discussing	Other on-task	Off task
			Experimental Group			
Boys						
same sex	10.0	15.5	58.6	3.9	7.1	4.9
mixed	10.8	10.7	58.8	7.0	7.4	5.3
Girls						
same sex	9.4	20.7	54.4	3.8	6.1	5.6
mixed	18.3	11.6	55.8	6.0	4.6	3.7
			Control Group			
Boys						
same sex	6.9	17.9	57.4	4.1	6.8	6.9
mixed	5.9	15.0	62.1	4.3	6.0	6.7
Girls						
same sex	10.1	22.0	49.5	5.1	7.5	5.8
mixed	24.0	22.4	37.6	4.9	3.9	7.2

Note Results are averaged using class as the unit of analysis

Table 2

Mean Time Spent Manipulating Equipment by Children in Different Groups

Group	Usual or Child-selected Partner		Teacher-selected Partner	
	n (classes)	Time (%)	n (classes)	Time (%)
		Experimental Teachers		
Boys				
same-sex	9	60.0	1	47.5
mixed	5	60.2	1	51.9
Girls				
same-sex	7	54.4	-	-
mixed	5	59.8	1	35.8
		Control Teachers		
Boys				
same-sex	5	59.0	3	54.6
mixed	3	55.3	3	68.8
Girls				
same-sex	5	53.4	3	42.9
mixed	3	38.6	3	36.5

Note Results are averaged using class as the unit of analysis.